

Before the
FEDERAL COMMUNICATIONS COMMISSION
 Washington, D.C. 20554

In the Matter of)
)
 Amendment of Parts 2.106 and 25.202 of the)
 Commission's Rules to Permit Operation of)
 NGSO FSS Systems Co-Frequency with GSO and)
 Terrestrial Systems in the 10.7-12.7 GHz, 12.75-)
 13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz)
 Bands, and to Establish Technical Rules)
 Governing NGSO FSS Operations In these Bands)

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FEDERAL COMMUNICATIONS COMMISSION
 OFFICE OF THE SECRETARY

OPPOSITION OF PANAMSAT CORPORATION

PanAmSat Corporation ("PanAmSat") hereby opposes the above-captioned petition for rulemaking (the "Petition"), filed July 3, 1997, by SkyBridge L.L.C. ("SkyBridge").¹ In the Petition, SkyBridge asks that the Commission amend Parts 2 and 25 of its rules to permit non-geostationary orbit ("NGSO") Fixed-Satellite Service ("FSS") systems to operate in the U.S. on a co-frequency basis with geostationary orbit ("GSO") FSS, Broadcast-Satellite Service ("BSS"), and terrestrial systems. For the reasons set forth below, PanAmSat opposes initiating a rulemaking to consider any such amendment to the Commission's rules.

DISCUSSION

SkyBridge has filed the Petition in order to secure changes in the Commission's rules that render ungrantable SkyBridge's application, filed February 28, 1997, for authority to launch and operate a global LEO satellite system using GSO frequencies. SkyBridge asserts that its LEO system, and others operating in conformity with the rules proposed in the Petition, can provide a variety of LEO services using GSO frequencies without interfering with GSO or terrestrial services. SkyBridge, however, has failed to support this claim, and PanAmSat's preliminary engineering report (attached) demonstrates that SkyBridge has not adequately addressed novel and complex interference issues. The rule changes sought by SkyBridge in its Petition, moreover, are inconsistent with the ITU's regulations.

¹ See FCC Public Notice 2213 (July 28, 1997).

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I. SkyBridge Has Failed To Demonstrate That NGSO Systems Using GSO Frequencies Can Avoid Causing Harmful Interference Or Otherwise Unnecessarily Encumbering The Frequencies.

GSO FSS and BSS operators have invested many billions of dollars in their systems. They made their investments knowing that the Commission's rules are intended to protect their operations against harmful interference from other satellite systems. Now, based on a largely theoretical engineering study that is technically insufficient, SkyBridge asks that the Commission put the industry's investment in GSO systems at risk by amending its rules to allow NGSO systems to share GSO spectrum. No such amendments are warranted on the current record.

The band sharing scheme proposed by SkyBridge gives rise to complex frequency sharing and interference avoidance issues, and SkyBridge's attempt to address these issues is inadequate. Given the difficult nature of these issues and the limited time available to comment on SkyBridge's Petition, PanAmSat could only prepare a preliminary technical analysis, a copy of which is attached, of SkyBridge's sharing plan. Even a preliminary analysis, however, leads to the conclusion that there are too many unresolved questions concerning the proposed sharing plan to commence a rulemaking predicated on GSO/NGSO sharing.

For example, SkyBridge has proposed an interference avoidance scheme that depends upon each of its satellites terminating transmission "so long as the satellite is within a predetermined geographic zone (+/- 10°) within which such transmissions could reasonably be expected to cause interference."² In fact, even initial engineering analysis indicates that the 10° avoidance angle proposed by SkyBridge may be less than optimal.³ SkyBridge, however, has failed to provide any analysis of the trade-off between system performance and interference potential as the avoidance angle for its system changes. Thus, the Commission can have no assurance that the proposed system is premised on anything more than half-considered theories and unstated, untested — and perhaps unrealistic — assumptions.

² Petition at 10.

³ See Engineer's Response to SkyBridge (attached) at 2.

PanAmSat's preliminary engineering study calls these theories and assumptions into question. For instance, even if the SkyBridge "on/off-switch" interference avoidance technique could be made to work for a single NGSO system attempting to share GSO frequencies on a non-interference basis, questions remain as to whether the technique would support two or more NGSO systems attempting to operate on this basis.⁴ Indeed, the cumulative effects of two or more "SkyBridge-like" systems would likely cause sufficient interference to constrain future system development in the band.⁵ Again, however, SkyBridge has failed to provide the kind of rigorous analysis or testing results required to evaluate these concerns. PanAmSat's study highlights other deficiencies as well.

In short, the SkyBridge application and Petition appear to have been submitted with a single objective — to obtain authority for SkyBridge's NGSO system in the U.S. using GSO frequencies. The SkyBridge submissions have not, however, meaningfully addressed issues related to the effect of the proposed rule changes on subsequent NGSO systems seeking to take advantage of the new rules, nor have they adequately analyzed the impact of the proposed rule changes upon existing GSO systems. In short, SkyBridge has failed to demonstrate that the rule changes proposed in the Petition could avoid harmful intersystem interference.

II. The Commission Should Not Amend Its Rules To Allow NGSO Systems To Use GSO Frequencies While Such Frequency Sharing Is Prohibited By ITU Regulations.

Not only is SkyBridge's technical analysis lacking, but its proposal conflicts with the ITU's regulations. As SkyBridge itself concedes, ITU radio regulations prohibit the operation of NGSO systems in some of the bands that it has proposed to use.⁶ SkyBridge gives short shrift to these prohibitions, claiming that it anticipates that they will be removed by action taken at WRC-97 or WRC-99.⁷

⁴ Id. at 3.

⁵ Id.

⁶ Petition at 16.

⁷ Id.

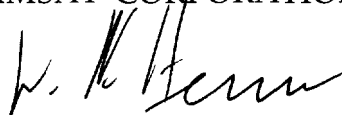
Whether or not the ITU will amend its radio regulations to accommodate SkyBridge and SkyBridge-like systems is purely a matter of speculation at this time. The Commission should not expend its scarce resources considering proposals to amend its rules to accommodate operations that may never be possible in accordance with ITU regulations. SkyBridge has, in effect, proposed a "cart-before-the-horse" rule change in the hope, perhaps, that it can then present the ITU with a *fait accompli* — the FCC having already blessed its operations in the relevant bands. The Commission should not allow its procedures to be used for leverage with the ITU, and it should not amend its rules (and certainly not license systems) in "anticipation" of ITU rule changes.

CONCLUSION

On the present record, SkyBridge has failed to demonstrate that NGSO systems can operate on GSO frequencies without causing harmful intersystem interference. Further, given that SkyBridge's proposed system and rule changes do not accord with current ITU regulations, it would be inappropriate for the Commission to consider amending its rules, much less grant a license, to allow NGSO systems to operate on GSO frequencies. For these reasons and those set forth above, SkyBridge's Petition should be denied.

Respectfully submitted,

PANAMSAT CORPORATION



By: /s/ W. Kenneth Ferree
Joseph A. Godles
W. Kenneth Ferree

GOLDBERG, GODLES, WIENER & WRIGHT
1229 Nineteenth Street, N.W.
Washington, D.C. 20036
(202) 429-4900

Its Attorneys

August 27, 1997

**Response from PanAmSat on the Petition for Rulemaking filed by
SKYBRIDGE L.L.C. before the FCC on July 3, 1997**

General

SKYBRIDGE proposes to operate its non-GSO FSS network by sharing frequency bands with other established networks in a manner which it claims that will cause no noticeable degradation in service to those networks.

SKYBRIDGE derive their conclusions assuming the following proposed frequency allocations:

Inter-System Interference between the GSO FSS and SKYBRIDGE (S-E/E-S)

Uplinks (GSO FSS sharing band)

12.75 - 13.25 GHz (Planned FSS, Ap30B)

13.75 - 14.0 GHz (Unplanned FSS, Art. 11 and 13)

17.3 - 17.8 GHz (Planned BSS)

Downlinks (GSO FSS sharing band)

10.7 - 10.95, 11.2 - 11.45 GHz (Planned FSS, Ap30B)

10.95 - 11.2, 11.7 - 12.2 GHz (Unplanned FSS, Art. 11 and 13)

12.2 - 12.7 GHz (Planned BSS)

SKYBRIDGE plans to employ "Orbital Avoidance" by ceasing all transmissions to/from the space station of the SKYBRIDGE network whenever that space station passes through a forbidden-zone within $\pm 10^\circ$ of the geostationary arc. The link is uninterrupted by transferring or "handing-off" the link to the closest adjacent satellite in the constellation which is not passing through the "forbidden zone" and is above 10° in elevation.

Inter-System Interference between the FS and SKYBRIDGE (S-E/E-S)

Uplinks (FS sharing band)

12.75 - 13.25 GHz (Cable Television Relay Service)

Downlinks (FS Sharing band)

10.7 - 11.7 GHz (Fixed Point-to-Point Microwave Services)

SKYBRIDGE plans to employ a Minimum Operational Elevation Angle” by ceasing all transmissions to/from the space station of the SKYBRIDGE network whenever elevation angle from a Gateway earth station to that space station approaches a minimum angle of 10°. The link is maintained by transferring or “handing-off” the link to the closest adjacent satellite in the constellation which is above 10° in elevation and not passing through the “forbidden zone”.

In addition, SKYBRIDGE has proposed not to use their ubiquitously deployed “User Terminals” in either the 12.75 - 13.25 GHz uplink band and the 10.7 to 11.7 GHz bands in effort to avoid burdening the Fixed Service with frequency coordination in these bands.

PanAmSat will comment on the following assertions made by SKYBRIDGE:

- a) SKYBRIDGE has proposed a non-GSO satellite network which plans to share the same bands as GSO FSS and BSS networks by using the most obvious of interference mitigation techniques, avoidance of geometrical alignments with the GSO orbit. The $\pm 10^\circ$ avoidance angle from the GSO has been offered as the degree of avoidance which is necessary to permit sharing with GSO FSS and BSS services.
- b) SKYBRIDGE has demonstrated that the manner in which it proposes to use the frequency bands with other services will not cause any noticeable degradations to those services nor will it receive any harmful interference from those services.

- c) SKYBRIDGE also claims that by sharing the frequency bands in the manner that they propose will not create undue burden to the growth or expansion of other networks.
- d) Grant of SKYBRIDGE's petition will enable the Commission to formulate a more generic regulatory structure designed to accommodate a variety of system architectures and approaches to interference avoidance.
- e) The hard limits of effective power flux density limits (e.p.f.d.) and the aggregate power flux density (a.p.f.d.) on the downlinks and the uplinks for the SKYBRIDGE system (and non-GSO FSS) systems in general, proposed by SKYBRIDGE are designed to protect GSO FSS and BSS systems and terrestrial FS systems in the subject frequency bands.

PanAmSat's comments on the five above assertions follow:

- a) SKYBRIDGE does not meaningfully address how to determine the appropriate avoidance angle. The $\pm 10^\circ$ from the GSO avoidance angle proposed by SKYBRIDGE might work in theory for the inter-system interference analysis which they present. A greater angle of avoidance, however, may be more appropriate without significantly affecting the cost effectiveness of providing the service. No such study analyzing the trade-off between cost and performance of this non-GSO FSS network and the impact on inter-system sharing with the FS and GSO FSS networks has been presented.

As the proponents of the SkyBridge system claim that non-GSO FSS satellite systems such as the one it is proposing can share the same Ku band spectrum as other such systems with the current users of the spectrum, namely the Fixed Satellite Service, the Broadcasting Satellite Service and the Fixed Service, and considering that some upper limit of interference will be reached above which the effective combined interference would be detrimental to current users of the band, what percentage of the total inter-system interference budget should be allocated to non-GSO FSS satellite systems? Until such time that an upper bound of aggregate interference resulting from the combined effect of all non-GSO FSS systems can be established by mutual agreement

among the parties affected, no changes to the “Rules” to allow non-GSO FSS systems to share these bands should be made.

As the effective interference due to one non-GSO FSS satellite network will differ from other such non-GSO FSS satellite networks, how does SkyBridge propose to establish limits on the number of such similar (or different) non-GSO FSS networks which can share the same frequency bands and not exceed the percentage of the total interference budget allocated to non-GSO FSS satellite systems assuming one has been established for each of the Fixed Satellite Service, the Broadcasting Satellite Service and the Fixed Service?

- b) Although, according to SKYBRIDGE calculations, long-term levels of interference produced by the downlink in both the FS and GSO FSS earth stations are within tolerable levels, the higher short-term levels do give cause for concern especially when one considers that the interference source, unlike a random and infrequent fading event, is characterized by a periodic and continuously variable function i.e. slightly less than worst case values of interference are produced at slightly greater percentages of time than the worst case occurrences. When considering the combined effect of the short and the long-term interference produced by the SKYBRIDGE Gateway-to-User downlink into a typical GSO FSS earth station, the short-term level of interference at 17.7 dB below the thermal noise-floor, when added to the “always present” level of long-term level of interference at 24.9 dB below the thermal noise-floor, is 16.9 dB below the thermal noise-floor (a 2% increase over thermal noise alone). The example calculation of short-term interference ($I/N_{st} = -11.6$ dB) into the Fixed Service given in Appendix C of the July 3, 1997 Minor Amendment, is also barely within acceptable limits. Furthermore, the long-term “background noise” contributed by any other non-GSO FSS systems sharing the band, as “SKYBRIDGE” admits is possible, would be additive. Both of these situations require further study as to their impact to the availability requirements, as specified in ITU-R F.1241, of either a terrestrial station

(or an earth station) forming part of 27,500 km long Hypothetical Reference Path (HRP).

- c) The petition argues that SKYBRIDGE's non-GSO system makes more efficient use of scarce spectrum resources by not requiring exclusive reservations of spectrum (i.e. finite orbital spacing along the GSO in a given frequency band). The question that still remains unanswered, however, is: "Does the non-GSO FSS network as proposed by SKYBRIDGE unduly constrain future non-GSO FSS entrants from implementing another non-GSO FSS network?" A preliminary analysis indicates that a non-GSO FSS network implementing GSO avoidance as an interference mitigation technique is not compatible with a quasi-geostationary FSS system since avoidance of the quasi-geostationary orbit would not be practical. If a SKYBRIDGE type system is permitted to go ahead, it may preclude the future implementation of any quasi-geostationary orbit FSS systems. It follows that further comparative studies of the benefits between the two types of systems should be completed before either system is granted the permission to share Ku-band FSS spectrum.
- d) Even if the claims of non-interference were true, granting SkyBridge's petition would set a dangerous precedent for accepting all of the arguments put forward by the proponent of a satellite system that their system operating in a well defined GSO FSS and FS interference environment will not cause unacceptable interference without first subjecting the new entrant to rigorous testing by an accepted method. Such rigorous testing should define minimum and maximum bounds of operation in terms of, for example; percentage of the globe served, worst case pfd levels, duration of interference events, spectral efficiency and amount of GSO avoidance employed, if applicable. The methodology in ITU-R IS.1143 for evaluating the effect of pfd levels in terms of the Fractional Degradation in Performance (FDP), as developed in ITU-R F.1108, on the FS from constellations of non-GSO Mobile Satellite Service (MSS) it could be argued is equally applicable for constellations of non-GSO FSS satellites as well.

- e) The hard limits for the protection of the FS and GSO FSS (and BSS) networks must undergo rigorous testing using an accepted method before they can be accepted. In any such analysis, the joint FS link fading and non-GSO visibility statistics must both be taken into account in order to determine the actual effect of the non-GSO FSS downlink on the FS. Res. 46 (WRC 95) of the ITU's Radio regulations provides an interim procedure for the coordination of frequency assignments for both the service and the feeder links of non-GSO MSS networks. Res. 46 proposes hard limits for both, however, non-GSO FSS networks were not included at the time it was drafted. Once appropriate interference criteria are determined and if the simple and detailed methods referred to in Res. 46 are applicable, the same methods could be extended to non-GSO FSS networks.

Other Concerns

Control over User Terminal Local Environment

Given that the ubiquitous deployment of non-GSO FSS transceiver terminals not unlike the ubiquitous deployment of BSS receiver terminals has been envisioned, what guarantees can the proponent of such a network offer that the intended operating environment as determined during initial implementation will be maintained?

As the proponents of the SkyBridge system claim that the system will be capable of operating in areas having local environmental blockages in some directions, what plan is there in place to ensure future compliance with a clear line-of-sight as the local environment changes after new structures are built in the local area which would change the local minimum elevation profile surrounding an existing terminal?

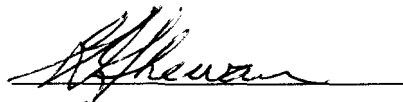
Inter-System Interference Impact of Satellite Diversity and Non-Operating Zone

As the proponents of the SkyBridge system claim that some of the spot beams can be “shut down” in the event of a known interference condition, then it would not be unreasonable to require each satellite to “turn-off” outer spot beams as the satellite approaches its most northerly and most southerly excursion from the equator to in effect reduce an otherwise increased effective power flux density (epfd) which would occur at higher latitudes. Given the geometry of this network, fewer satellites are required to provide continuous coverage to regions between 30° and 60° latitude. It would be preferable to have a nominal operating mode where the primary sub-constellation would provide service to latitudes between 30° and 60° using only the minimum number of spot beams necessary to provide continuous coverage and to use a satellite from the other sub-constellation when the satellite from the primary sub-constellation crosses through the non-operating zone with respect to the Gateway earth station.

Respectfully Submitted:

Date: August 27, 1997

By:



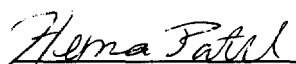
Gerald D. Shewan,
Professional Engineer

Philip A. Rubin & Associates Inc.
1350 Connecticut Avenue, Suite 610
Washington, DC 20036

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing Opposition to PanAmSat was sent by first-class mail, postage prepaid, this 27th day of August, 1997, to each of the following:

Phillip L. Spector
Jeffrey H. Olson
Diane C. Gaylor
Paul, Weiss, Rifkind, Wharton
& Garrison
1615 L Street, NW
Suite 1300
Washington, DC 20036


Hema Patel

* By Hand